Air Quality Impacts of the Use of Ethanol in California Reformulated Gasoline

January 18, 2000

California Environmental Protection Agency

Air Resources Board

Presentation Outline

- Introduction
- Review of Prior Studies
- Emission and Air Quality Predictions
- Resolution of Uncertainties
- Conclusions

Introduction

Study Approach

- Review recent assessments of oxygenated gasolines
- Review ambient air quality studies
- Predict emission and air quality impacts of MTBE-free gasolines
- Address data gaps

Compounds Studied

Ethanol $\rightarrow$ Acetaldehyde $\rightarrow$ PAN

MTBE $\rightarrow$ Formaldehyde

Alkylates $\rightarrow$ Aldehydes $\rightarrow$ PAN

Others

- **benzene, 1,3-butadiene**
- ***n*-heptane, *n*-hexane, isobutene, toluene, xylenes**
- **PPN, ozone, CO, NO_2, PM10, PM2.5**

Review Process

- Public
  - Individual stakeholder meetings
  - Workshops on 7/12, 10/4, and 11/10
  - ARB hearing on 12/9
  - Web page with email notification
- Scientific
  - Contract emission and PAN experts
  - Formal University of California peer review

UC Peer Reviewers

Professor Roger Atkinson (UCR)

Professor Barbara Finlayson-Pitts (UCI)

Dr. Donald Lucas (LBNL/UCB)

Professor John Seinfeld (Caltech)

Review of Prior Studies

Recent Assessments of Oxygenated Gasolines

- Reviewed 8 reports
  - UC MTBE Report
  - U.S. EPA Blue Ribbon Panel
- Identified issues of concern
- Lacked review of ambient air quality studies and analysis of MTBE-free fuels

Emission Issues

- Commingling mitigated by CaRFG3 regs
- Permeation and canister working capacity
  - Comparison to MTBE needed
  - Addressed by U.S. EPA Tier 2 certification fuel
- Transportation of ethanol
  - 0.06% increase in truck emissions
  - Local impacts addressed by CEQA

Ambient Air Quality Studies

- Reviewed 16 articles and reports
  - U.S. (Denver, Albuquerque)
  - Brazil
- Air quality impact substantial only in Brazil with high-ethanol fuels and no RVP limits

Emission and Air Quality Predictions

Methodology

Focus on South Coast Air Basin

Estimate emissions for airshed modeling

Model air quality for 1997 and 2003 episode

Use model results to scale measured 1997 air quality baseline to 2003

Fuels

Current MTBE-based Phase 2 CaRFG

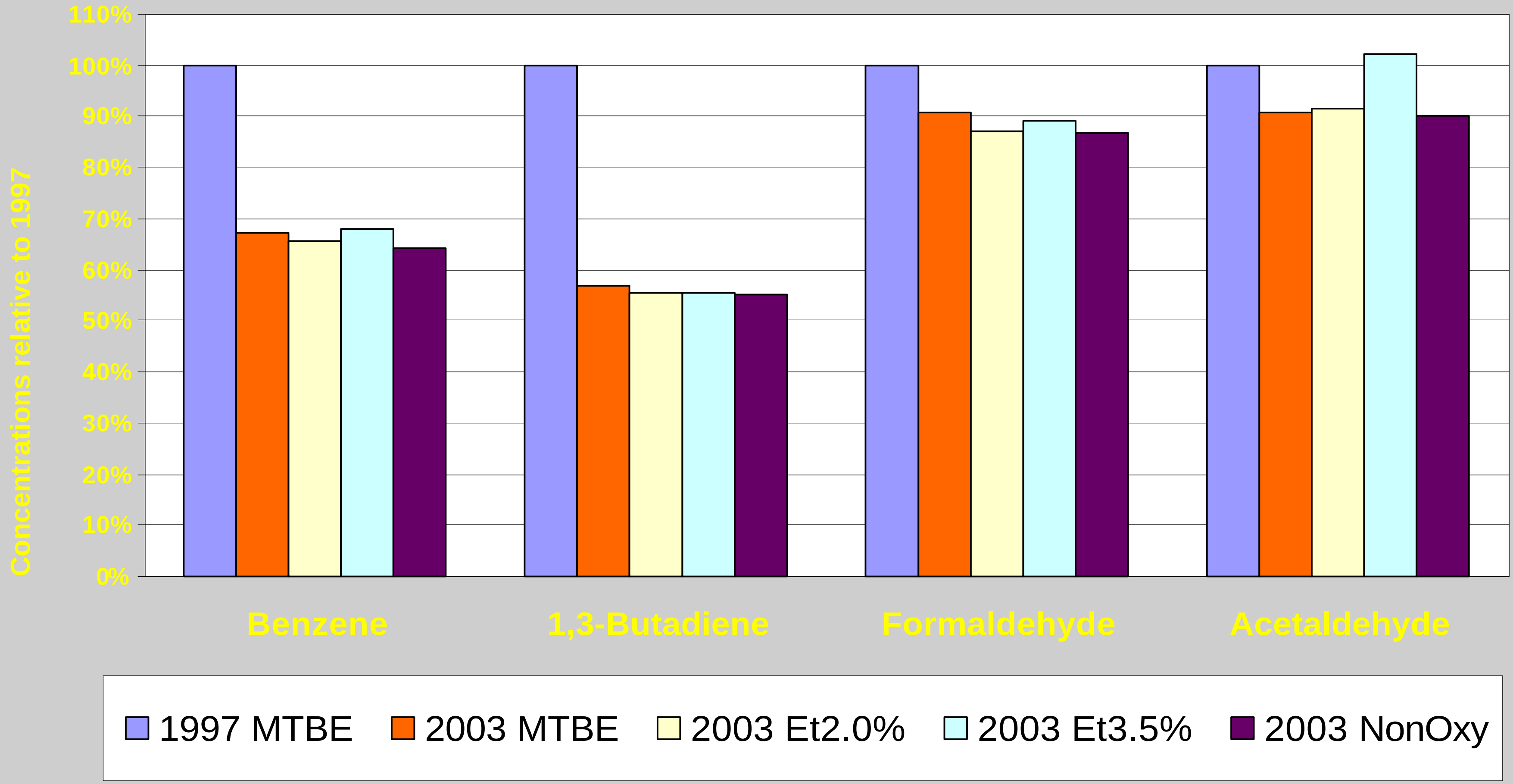
    1997 and 2003

Ethanol blend at 2.0 wt% oxygen (5.7%)

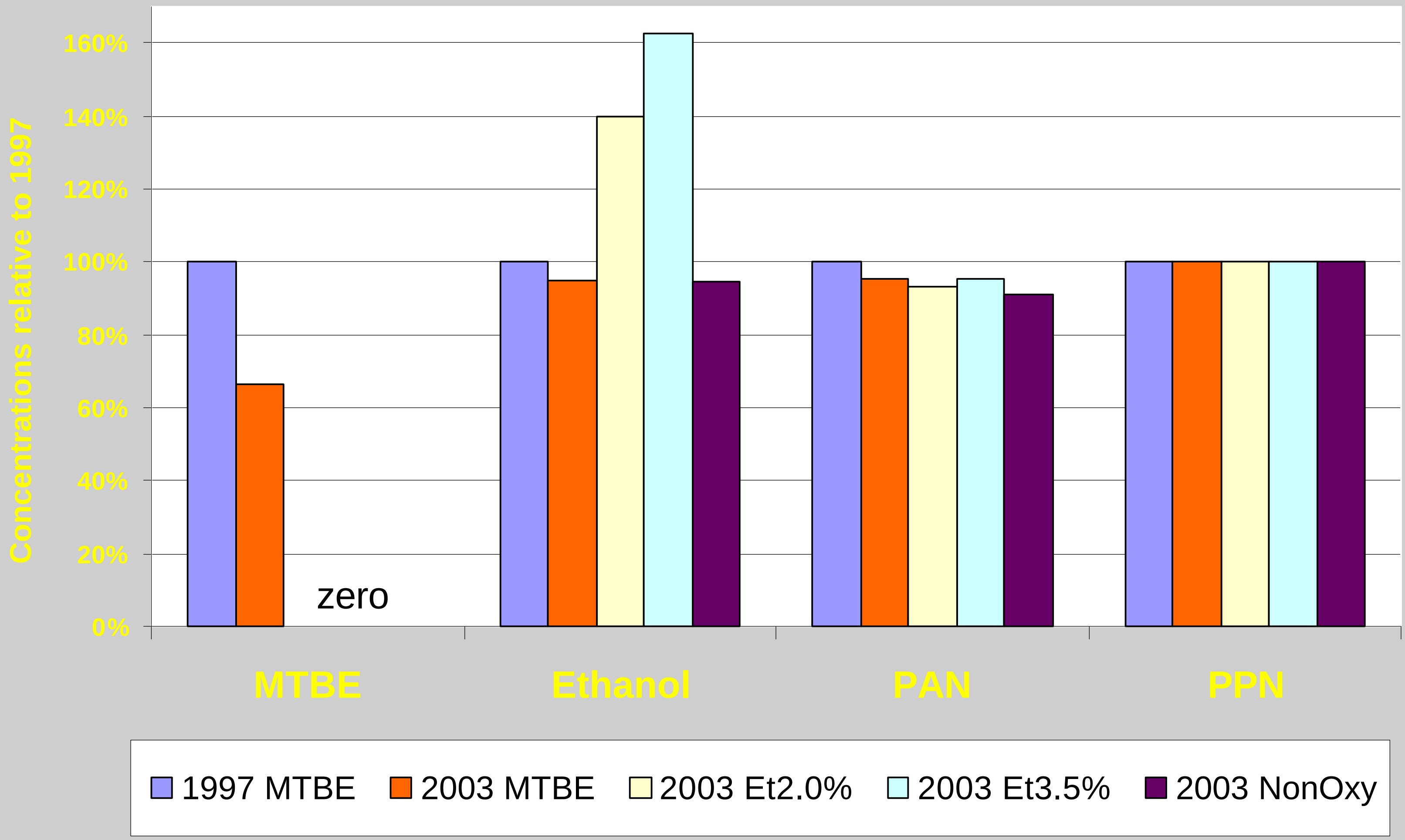
Ethanol blend at 3.5 wt% oxygen (10%)

Non-oxygenated fuel

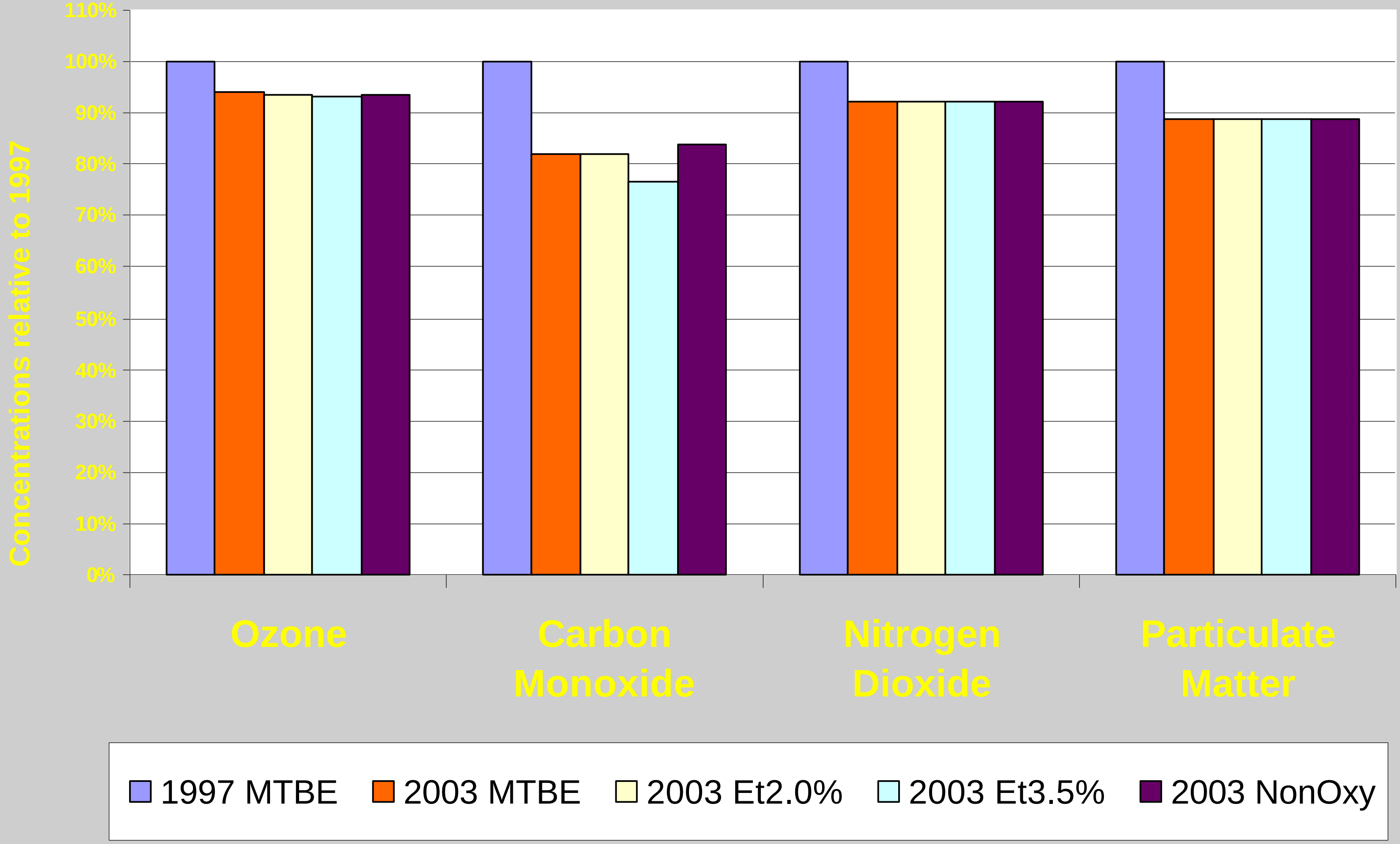
Predicted Average Concentrations for Toxic Air Contaminants



Predicted Maximum Concentrations for Other Pollutants of Concern



Predicted Maximum Concentrations for Criteria Pollutants



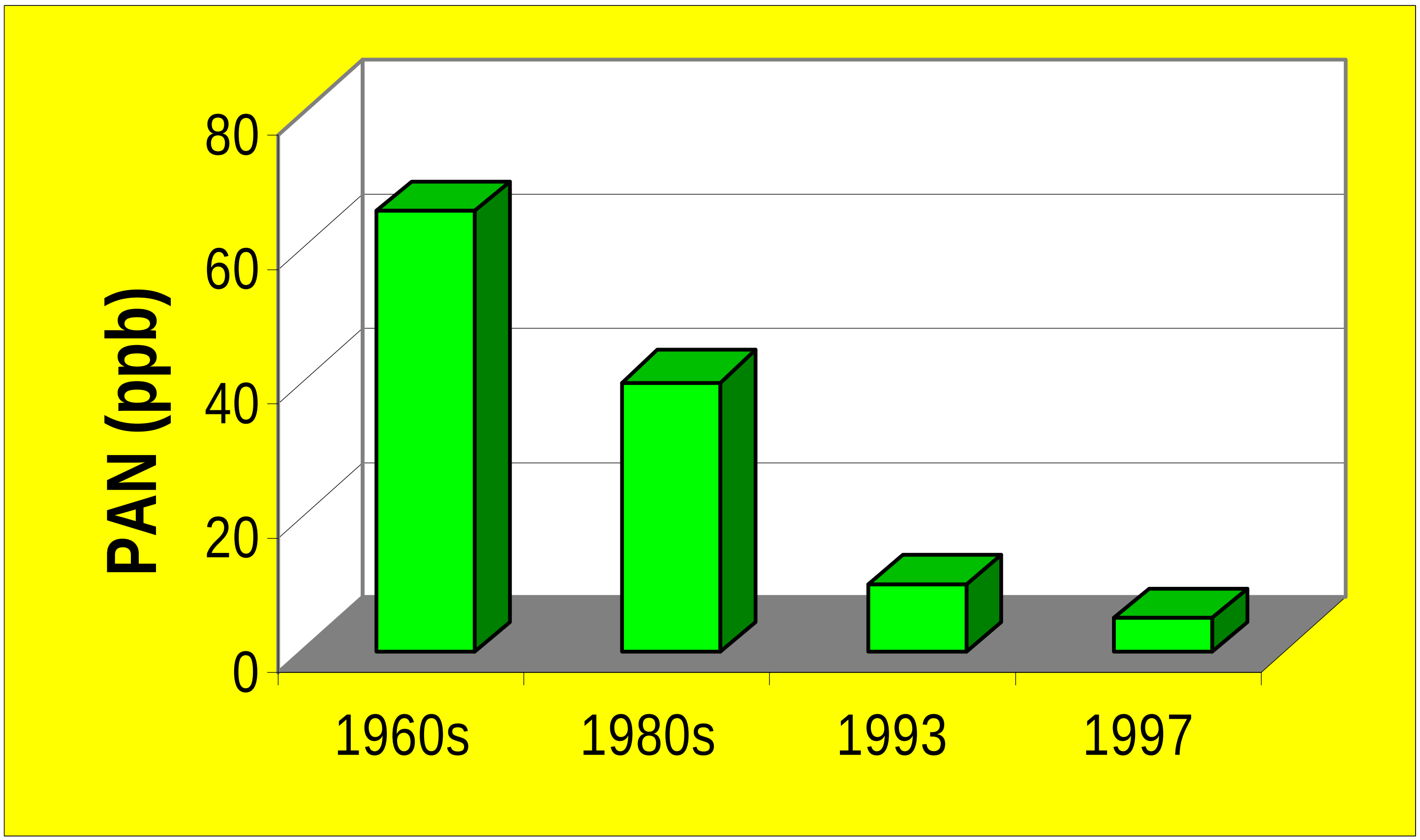
Other Results

No indication of health problem with alkylates from OEHHA

***n*-Heptane, *n*-hexane, isobutene, toluene, and xylenes below level of concern**

Simpler models for South Coast Air Basin and Brazil support lack of PAN formation from ethanol substitution

Ambient PAN Measurements in South Coast Air Basin

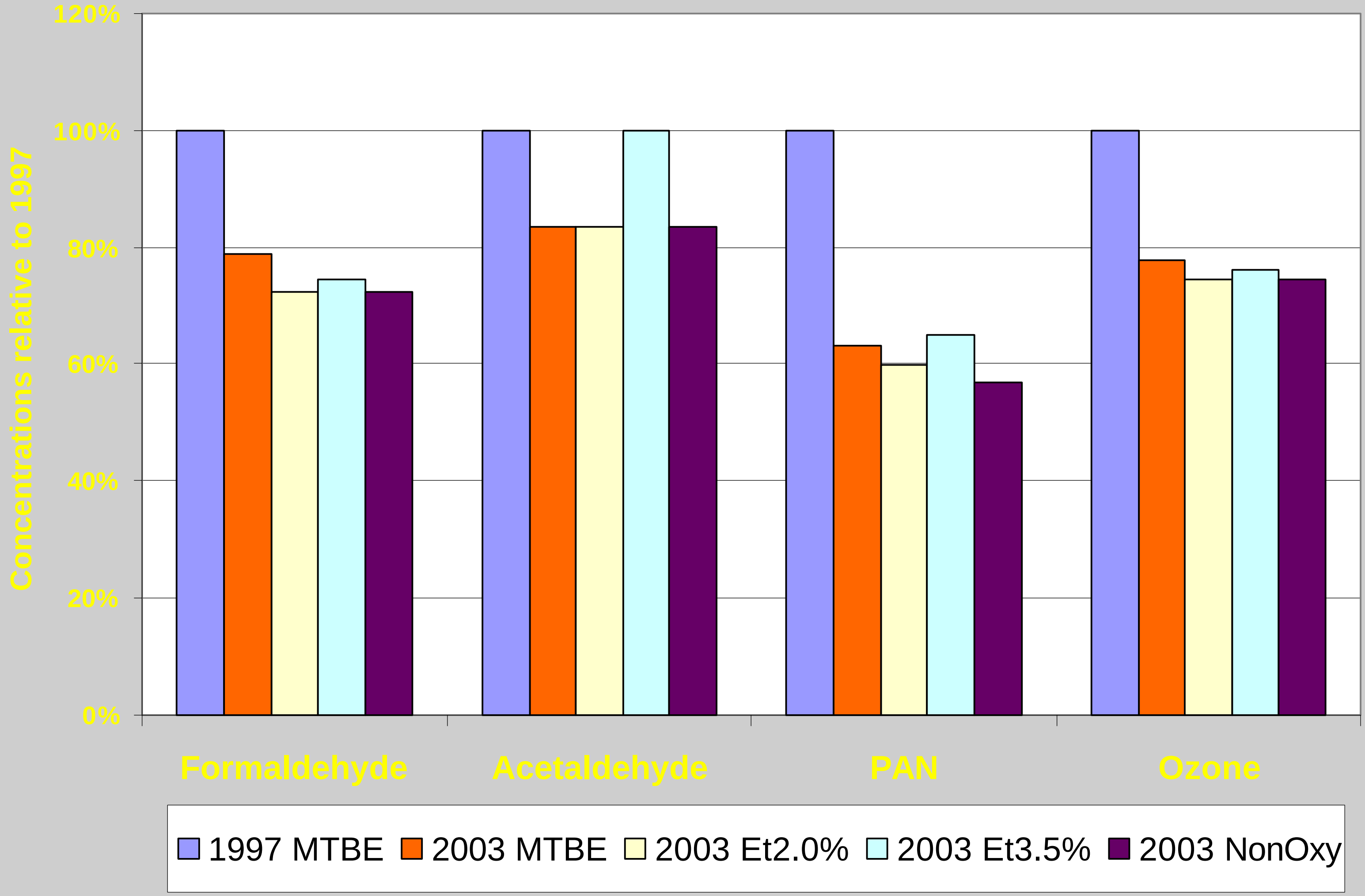


Resolution of Uncertainties

Uncertainties

- Emissions
  - Effect of EMFAC2000 bracketed
- Modeling
  - Chemistry of ethanol, MTBE, and alkylates are well-known
  - Chlorine chemistry included
  - Use in relative sense bypasses other issues

Upper-Bound Concentrations for Selected Pollutants



Ambient Air Quality Monitoring Program

- Measure air quality impacts of fuels
  - Criteria pollutants and toxic air contaminants already monitored
  - PAN monitoring began in November
  - Ethanol method needs development

Conclusions

Conclusions

So long as the CaRFG3 regulations address the potential for ethanol usage to increase evaporative emissions and to cause more rail and truck traffic, the substitution of ethanol and alkylates for MTBE in California's fuel supply will not have any significant air quality impacts.

Conclusions, cont.

The results of this study do not necessarily extend to other states. States without CaRFG3's unique safeguards may have significant air quality impacts from replacement of MTBE with ethanol or aromatic compounds.